

ACD VETO SIGNALS AND EFFICIENCY

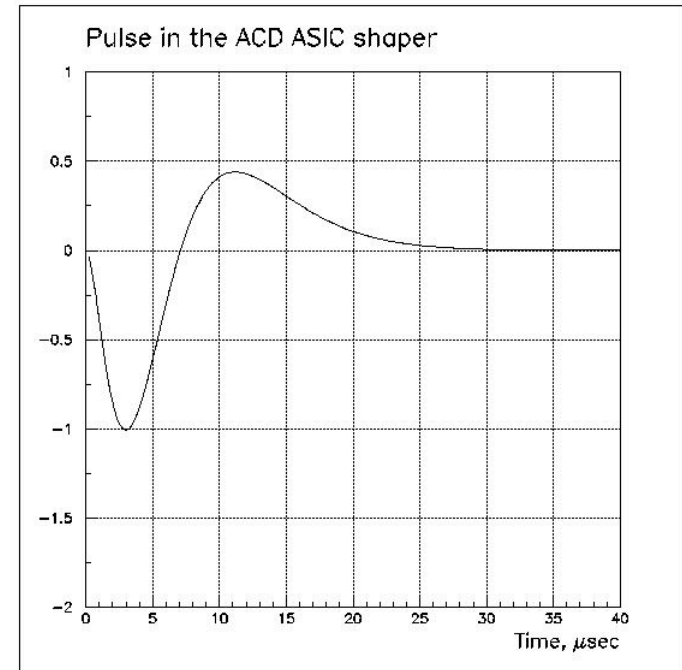
With the recent changes, the following ACD VETO signals will be generated:

- **AEM VETO HIT MAP, created by ACD Electronics Module (AEM), from VETO signals shortened (in the ACD) to approximately 250 ns to reduce LAT dead time. These signals can be used in L1T. The required ACD efficiency (0.9997) CANNOT be achieved with these signals alone, due to pile-up effects.**
- **ACD VETO HIT MAP, created in ACD. These are VETO signals with the same thresholds, but with duration to cover the ACD time-over-threshold plus baseline recovery. These signals are free of pile-up effects, and potentially can provide the required efficiency with properly set thresholds. These signals will be used only in ground analysis.**

(Differences between the two hit maps indicate the occurrence of pile-up.)

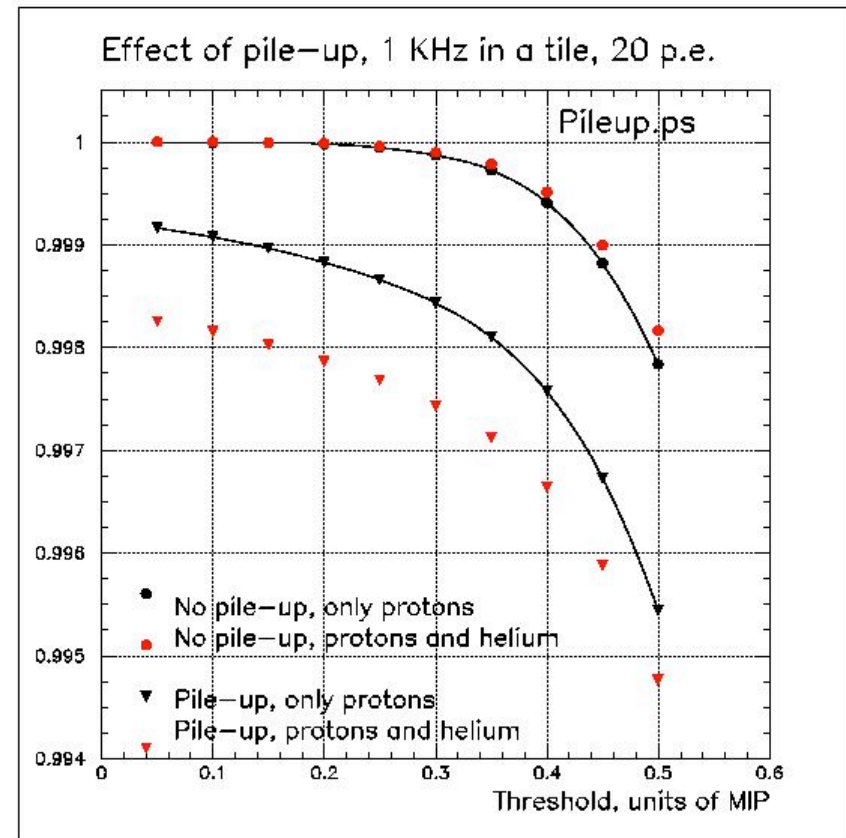
- **ACD PHA. This information will be used in ground analysis for precise threshold setting and to provide the required efficiency and backslash self-veto reduction.**

Until two weeks ago, our idea was to **use the PHA in ground analysis to set precise ACD thresholds to be used for the science analysis.** This allows us to set higher thresholds in the ACD discriminators to be sure that efficiency to the high energy gamma-rays is close to 1. This is supported by the fact that in L1T, ACD is used only to reduce the rate to an acceptable level. This reduction is provided mainly by the geometrical coverage for each particular tower rather than by the ACD efficiency.

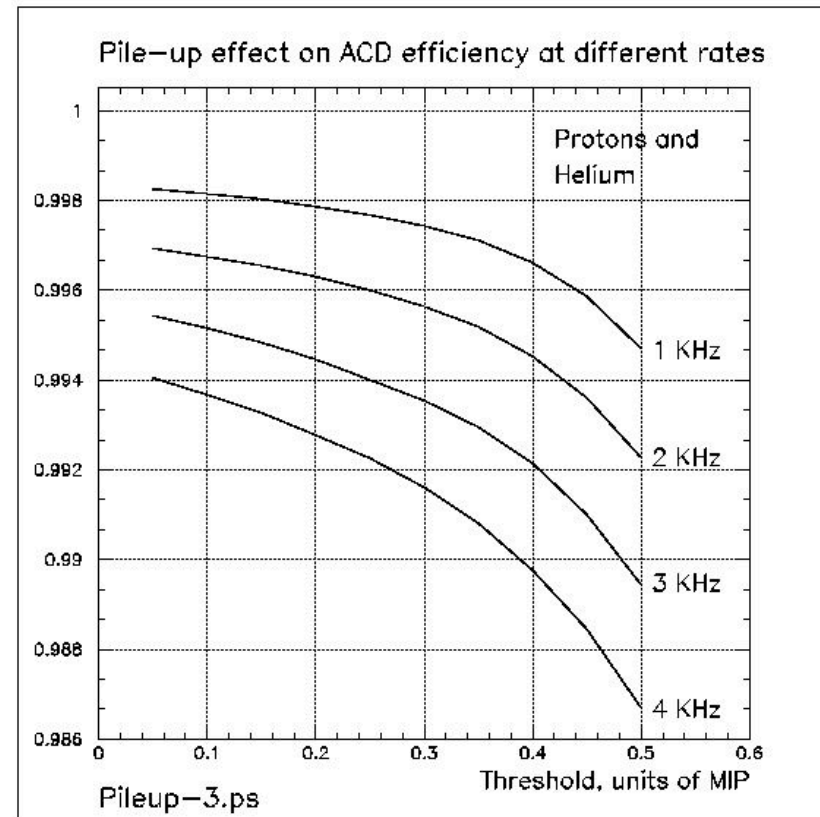


Shaped pulse for PHA in current ASIC design

Simulations of the pile-up effect for the signals for PHA demonstrate that they CANNOT be used alone for the science analysis, because of inadequate efficiency due to pile-up. These simulations utilize isotropic illumination by cosmic rays, and include pulse-height and read-out time fluctuations. Protons, helium, and CNO nuclei are included, assuming a rate of 1.15 KHz per single tile. The signal shape used was shown on the previous page.

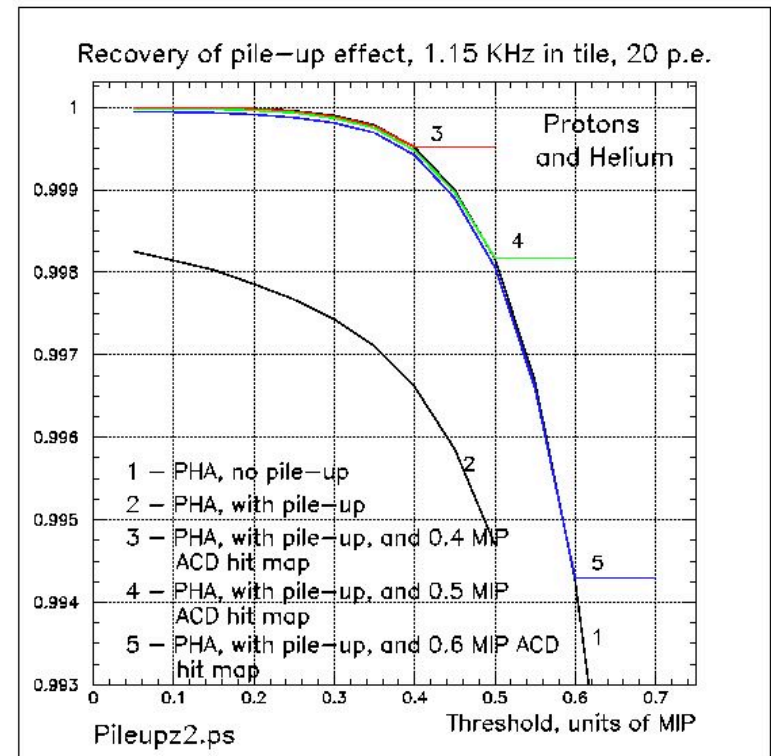


The pile-up effect for different cosmic ray rates. Rates are expected to range from 0.15 to 3.8 kHz in various tile and over the orbit extremes



Possible solution. In the ground analysis, use the PHA signal **OR'ed** with ACD VETO HIT MAP, which is assumed to have negligible pile-up effect. An intentionally high threshold is used for the hit map (to avoid backslash self-veto on-board).

Used 0.4 MIP threshold for ACD hit map, and OR'ed it with adjustable threshold for PHA. The encouraging result is explained by the fact that the product of the probabilities to have both a short interval (≈ 10 microsec) between events and a large fluctuation (below 0.4 of the mean value) in the pulse height is very small - these fluctuations are independent.



This approach to recover the efficiency works at higher rates as well. Rates up to 4 KHz through the single tile were simulated - still OK.

We believe that the problem is closed.

